

PROBLEM SET 6

1. K&K problem 6.1 “Show that if the total linear momentum...”.

2. K&K problem 6.3 “A ring of mass M and radius R lies...”.

3. Expansion of the previous problem:

(a.) Let the azimuth of the bug on the ring be ϕ – that is, ϕ is zero when the bug starts walking, and 360° when the bug makes one revolution. Assume (for part (a.) only) that the ring is fixed. Calculate the angular momentum l of the bug about the pivot in the previous problem, as a function of ϕ . Check that your result is consistent with what you used in the previous problem when ϕ was 180° .

(b.) Now assume that the bug is fixed at some azimuth ϕ on the ring, but that the ring itself is not fixed, having angular velocity Ω about the pivot (opposite to the angular velocity of the bug when the bug was moving). Calculate the angular momentum l' of the bug as a function of Ω and ϕ .

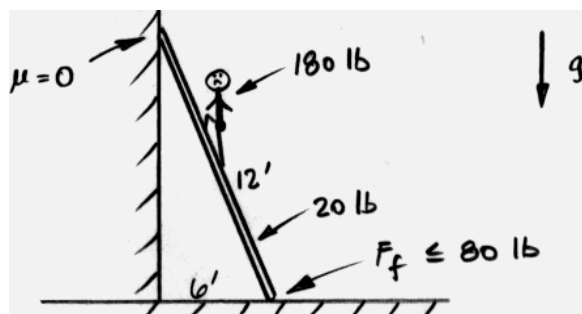
(c.) Now assume that neither the bug nor the ring are fixed. By requiring that the total angular momentum $l + l'$ of the bug about the pivot be balanced by the angular momentum of the ring, obtain an expression for the angular velocity Ω of the ring, as a function of ϕ .

(d.) Get an integral expression for the angle θ through which the ring rotates, as a function of time, assuming that $d\phi/dt = \omega = \text{constant}$. You need not evaluate the integral. Note that the system is “bootstrapping” its way around the pivot!

4. K&K problem 6.5 “A 3,000-lb car is parked on a...”.

5. A man begins to climb up a 12-ft ladder (see figure). The man weighs 180 lb, and the ladder 20 lb. The wall against which the ladder rests is very smooth, which means that the tangential

(vertical) component of force at the contact between ladder and wall is negligible. The foot of the ladder is placed 6 ft from the wall. The ladder, with the man’s weight on it, will slip if the tangential (horizontal) force at the contact between the ladder and ground exceeds 80 lb. How far up the ladder can the man safely climb?



6. K&K problem 6.8 “Find the moment of inertia of a uniform sphere...”.

7. K&K problem 6.14 “A uniform stick of mass M and length L is...”.

8. K&K problem 6.18 “Find the period of a pendulum...”.